who have shown that in certain cases only one species exists in a region where the presence of bad pollen is supposed to have proved hybridisation. Messrs. Brainerd and Peitersen have made a study of the New England Rubi (Vermont Agric. Expt. Sta. Bull. No. 217), in the course of which they find much hybridisation and no forms with entirely good pollen; they are therefore inclined to accept this dictum. That "bad pollen" is unsafe as a criterion of hybridity is shown, however, by other results. For example, Profs. Gates and Goodspeed (*Science*, 1916, p. 859), examining the pollen of various Californian species, found a variable proportion of bad pollen in *Trillium giganteum*, the nearest relative of which is in the Eastern States; *Dirca occidentalis*, the only other species being in eastern North America; and *Scoliopus Bigelovii*, a remarkably isolated genus of Liliaceæ, the only other species of the genus occurring much farther north.

That sterility or fertility of pollen is an inherited character has been shown in the sweet pea by Bateson and in the velvet bean (Schizolobium) by Belling, and it is reasonable to conclude that the occurrence of bad pollen may result not only from crossing, but also from mutation and from physiological or environmental conditions.

Geography in Austria.

By Prof. Grenville A. J. Cole, F.R.S.

THE Geographical Society of Vienna continued its octavo *Mitteilungen* throughout the war-years, though the style *kaiserliche königliche* perforce disappeared from its title with the issue of No. 12 in November, 1918. Few contributions could be expected from Austrian travellers in unusual fields, but the reviews of current exploration in all parts of the globe have kept the members up to date. The editors in 1914 were Drs. Fritz Machatschek and Hermann Leiter. The former became sole editor for 1915, and the latter acted from 1916 onwards. One naturally looks at first for special studies arising out of war-conditions. As early as October, 1914, Oberstleutnant Josef Paldus (vol. 57, p. 395) reviewed the system on which maps are grouped in the Kriegsarchiv in Vienna. This collection is rich in materials for students of history, and is by no means restricted to maps that will help modern armies in the field. It originated in an official military library formed by Prince Eugene of Savoy, whose frequent crossings of the Alps, and campaigns from Douai to Belgrade, must have impressed him deeply with the value of cartography. The kindly autocrat Joseph II. organised a detailed survey of the Austrian lands, remarking that to rule well required an accurate knowledge of the country. So long as he lived the collection of geographical material was carried on in a most liberal spirit. The position of Austria soon caused its military cartography to extend over adjacent lands, and Viennese maps are still our best authorities for a large part of the Balkan States. The sheets of the beautiful map of central Europe, on the scale of 1 : 200,000, which are frequently revised, are, moreover, among the best aids to travellers in southern Germany, northern Italy, Bosnia, and Poland. Oberstleutnant Paldus gives the date of inception of this series as 1907; but the Szombáthely sheet was issued in 1897, and the present writer used many others in road-journeys between Vienna and Sarajevo in 1899. The previous 1 : 300,000 map, remarkable in its time, seems to have escaped mention.

During the recent war Austrian observers were able to penetrate Albania from the north. Baron Nopcsa (vol. 59, p. 520, 1916) has utilised his collection of maps for an interesting summary of cartography in the region, beginning with the coast of "Dyrrachio" about A.D. 250. The paper is illustrated by numerous drawings from maps of the Cattaro-Dulcigno district, coming down to 1914. Eugen Oberhummer (vol. 61, p. 313, 1918) describes a journey with other members of an intelligence-bureau during the occupation of Montenegro and Albania. He directs attention to the map of Serbia, 1 : 75,000, completed by that State in 1888; this was repeated, from 1897 onwards, by an Austrian edition, in which the names are in Roman characters. Albania remained unsurveyed; Baron Nopcsa looked forward to the publication of Austrian work done during the war. Meanwhile, many things have happened, and the region has again eluded the embrace of an interested group of nations. Oberst Hubert Ginzl (vol. 61, p. 497) illustrates, by reproductions from the older sheets and the coloured and contoured new editions, the immense improvements made in the maps of Serbia and Albania under the stress of war. The older issues might guide troops along the highways, but were found useless for tactical dispositions. E. Nowak (vol. 62, p. 211, 1919) describes progress made by the war-geologists eastward from Durazzo and Valona. One wishes that peaceful international relations could ensure the completion of the good work thus begun.

In vol. 61, pp. 609–40, and vol. 62, pp. 25–40 (1919), six authors discuss, from various points of view, morphological, climatic, faunistic, and anthropological, how far natural boundaries can be assigned to Poland as marked out by the peace-terms. H. Praesent, in the anthropogeographical article, points out how the boundary between different types and grades of culture strikes the eye as one enters Poland—at Illowo, for instance—in the absence of any morphological feature. Even Galicia, with the glorious city of Krakow as a centre, has hung behind from a material point of view. The matter is not entirely due to political conditions. Anyone who knows the village inns, as compared even with those of Hungary, will agree that Praesent's observation is not inspired by race sentiment. Indeed, such sentiment as is allowed within the walls of the Geographical Society of Vienna seems directed towards a distant and hypothetical England, figuring as a corsair on the seas.

Anthropologists, such as Josef Weninger (vol. 61, p. 143, 1918), took advantage of the prisoners' camps to study unfamiliar folk. The Georgians are especially complimented on their understanding and on their sympathy with the spirit of research.

Among historical studies Hans von Voltelini (vol. 59, p. 181, 1916) gives a valuable account of the origin of the southern boundaries of Austria before the war, which, of course, serves to rectify some current judgments. There are, for instance, writers who forget that Trieste escaped in 1382 from warfare with Venice to the security of Habsburg rule, and remained under this "domination" for more than five hundred years. The Austrians, however, did not become long-distance seamen until the sixteenth century. Prof. Eduard Zenker contributes papers on the Roman roads of Austria. "Karnuntum—Vindobona" (vol. 60, p. 507, 1917) reminds us of how Rome is still remem-

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bered. We halted one golden evening at the little inn of Petronell, and praised the wholesome quiet of the spot. "Yes," replied the ostler, "Marcus Aurelius loved it well." It was not until the next morning that we saw the ruins of Carnuntum by the road.

As an example of European study we may note that Fritz Machatschek (vol. 60, pp. 235 and 274) describes the southern flanks of the Erzgebirge. This chain must no longer be regarded as an Armorican anticlinal ridge, but has been determined by successive bulgings of the floor from Lower Oligocene times onwards. Terrace-regions on the south represent portions of the main gently curved surface that have been lowered by faulting, and the well known volcanoes that produce such variety in the landscape are manifestations of earth-movements that continued into the Quartary (Quaternary) era. The evidence of such movements is seen in the stages by which the Eger Valley has been deepened. To turn to farther fields, economists and politicians will find much of interest in H. Leiter's review (vol. 62, pp. 414 and 433, 1919) of the present railway-system of Africa. The unfinished Cape-to-Cairo route now offers few attractions in view of the proposed cross-cut from Bukama, its present terminus, to the Congo mouth, a point quickly reached by sea from England. The numerous recent developments from the coasts of the Mediterranean, the Red Sea, and the Indian Ocean are described, and the dry details soon link themselves together as a romance. "Un tourbillon de sable," we once said to our guide, looking south over the Sahara, where a cloud rose among the dunes. "Pardon, monsieur," he replied, "c'est le chemin de fer." The railway was going forward to Touggourt.

The comprehensive paper by C. Diener on "Die Groszformen der Erdoberfläche" (vol. 58, p. 329, 1915) concludes that continental blocks and ocean-basins have shown permanence, at any rate since Permian times. Such work takes us into wider fields than Eugen Oberhummer's interesting discussion of imperialistic policies (vol. 63, p. 101, 1920) or H. Hassinger's well reasoned attempt to define the boundaries and the qualities of a Middle European region (vol. 60, p. 437, 1917). Both these essays in political geography provide much food for thought, and Hassinger's remark on the mixture of races between the Straits of Dover and the Black Sea is worth quoting: "Reiner Nationalstaat und Panslawismus sind Mitteleuropa fremd und wirken hier unnatürlich."

More illustrations are needed for papers dealing with natural features; but this defect must not be charged against those who have done their best to advance knowledge through the war-time.

Valence.

In an article on "Types of Valence" in *Science* for July 22 Dr. Irving Langmuir develops still further the views on this subject which are associated with his name. He points out that the term "valence" has been used to describe (1) *positive valence,* or the number of electrons an atom can give up; (2) *negative valence,* or the number of electrons an atom can take up; and (3) *covalence,* or the number of electrons an atom can share with its neighbours. He brackets the first two under the name of "electrovalence," and accounts for them by the tendency to form a *complete layer* of 2, 8, 8, 18, 18, or 32 electrons (First postulate). The outer *incomplete* layer of electronegative elements, such as oxygen and the halogens, which tend to take up electrons, is distinguished as a *sheath,* and this term is used even when the atom has taken up electrons, so that the outer layer has become for the time a *completed sheath* in the negatively charged ion. The same term is also used in the case of the electropositive elements to describe the small excess of electrons which are lost when the atom becomes a positively charged ion.

The simplest complete layer consists of two electrons (*e.g.* in He or $H+$) in close proximity to a nucleus; such a pair of electrons is called a *duplet,* and this term is extended to include any pair of electrons which is rendered stable by its proximity to one or more positive charges. The third type of valence is then controlled by the second postulate that "two atoms may be coupled together by one or more duplets held in common by the completed sheaths of the atoms."

Since each duplet eliminates two electrons as compared with those required to form a pair of complete sheaths, it follows that the algebraic sum of the electrovalences and covalences for all the atoms in any *complete compound* (*i.e.* a compound in which the sheaths of all the atoms are complete) is zero. Complete compounds without covalence include NaCl, $BaBr_2$, K_2S; MgO, BN, Al_2O_3; AlF_3, PCl_5, SF_6, etc. In these last compounds the halogens have seven electrons on the sheath of the atom, and therefore an excess of seven positive charges on the "kernel" (*i.e.* the atom *minus* the sheath), which creates a very strong attraction and enables these atoms to drag away as many as five electrons from an atom of phosphorus and six from an atom of sulphur. When no positive atom is present the electrovalence of every atom must be negative; no atom can lose electrons, and only covalence can exist. In this case the ordinary use of structural formulæ is legitimate; when electrons are transferred instead of being shared it is not. Since the sheaths of atoms of atomic number less than about 25 never contain more than eight electrons, the covalence of these atoms can never exceed four. With heavier atoms larger covalences may occur occasionally, *e.g.* in $Ni(CO)_4$, $Fe(CO)_5$, and $Mo(CO)_6$ the number of atoms in the sheath of the metallic atom is 10, 8, and 6, or 8, 10, and 12 less than the number required to make a complete sheath of 18 electrons. We therefore have negative valences of 8, 10, and 12, as indicated by the formulæ of the three carbonyls.

Incomplete compounds, containing atoms with incomplete sheaths, are particularly abundant in intermetallic compounds where only electropositive atoms are present, each with a sheath very far from complete. Thus in the two long periods 18 electrons are needed to complete the sheath, whilst, as a rule, only 4 can be lost (maximum positive valency equals 4) in order to remove it; there are therefore 14 elements which are compelled to retain electrons in the outer layer, and very few of these can complete their sheaths. These elements are, therefore, exclusively metallic in character, and even their compounds with electronegative elements usually contain loose electrons in incomplete sheaths and often exhibit metallic conductivity. The small and irregular positive valences of the transition-elements of the two long periods depend on the fact that their sheaths contain from 5 to 13 electrons, of which, as a rule, only 2, 3, or 4 can be detached to make a kathion.

The article is ingenious and suggestive, and represents a distinct advance in the process of explaining why and how combination between atoms takes place.

T. M. L.

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